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Some New Genera and
Species Echinodermata



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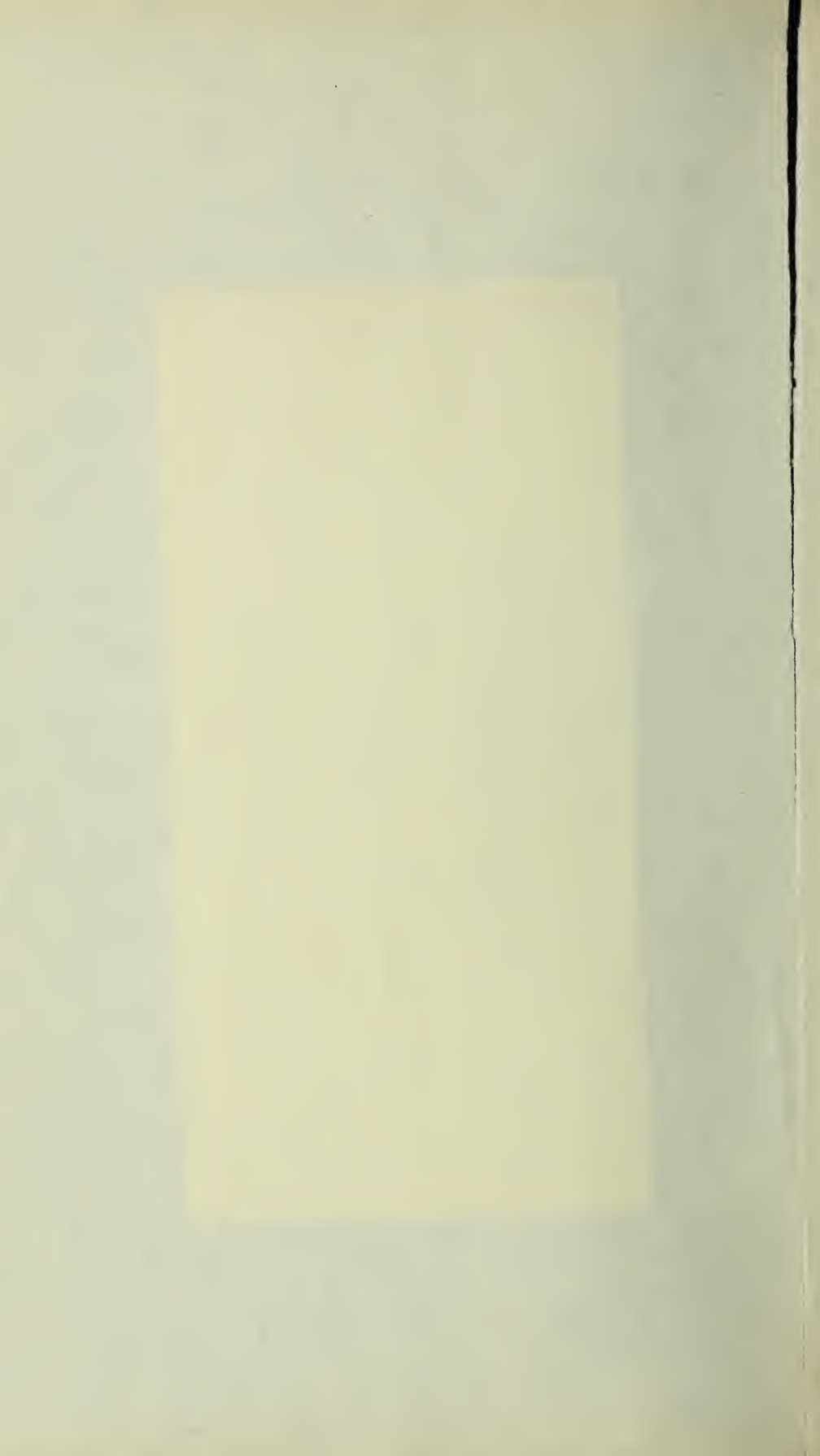
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Description of some
new genera & species
of
echinodermata

by

S. A. Miller & W. F. E. Gurley



From the April number of Vol. XIII., of the Journal of the Cincinnati Society of Natural History, published April 28, 1890.

DESCRIPTION OF SOME NEW GENERA AND SPECIES
OF ECHINODERMATA, FROM THE COAL MEAS-
URES AND SUBCARBONIFEROUS ROCKS
OF INDIANA, MISSOURI AND IOWA.

BY S. A. MILLER AND WM. F. E. GURLEY.

LAST summer, Sidney J. Hare, E. Butts and D. H. Todd collected a lot of very fine crinoids in the Upper Coal Measures, at Kansas City, Missouri, many of which have fallen into the hands of one of the authors of this paper, Mr. Gurley. They are the finest specimens ever found in the Coal Measures, and it is, therefore, a pleasure to describe them. The stone quarries in the Waverly or Kinderhook Group, at Legrand, on the Chicago and Northwestern Railroad, in Marshall County, Iowa, contain some layers of yellowish, soft, sandy limestone, bearing the remains of Crinoids and other Echinoderms in a remarkably fine state of preservation, and Mr. Gurley visited the locality soon after its discovery, and succeeded in obtaining a large collection. He has been an active collector, in the rocks of Indiana, Illinois, Iowa and Missouri, for many years, and all the specimens here defined and illustrated are from his cabinet.

EUPACHYCRINIDÆ. n. fam.

The genera for which we propose the family name of Eupachy-
crinidæ, with the Genus Eupachycrinus as the type, all belong to
the Subcarboniferous System and Coal Measures. The calyx is
more or less globular or bowl-shaped, and consists of five basals,
five subradials, five primary first radials, concave internally with a
broad upper face, from one to three azygous interradians and no
regular interradians. There are one or more brachials, and the
arms are composed of a double series of interlocking plates, which
bear short pinnules. The column is small and round. We include
in the family Eupachycrinus, Delocrinus and Ulocrinus.

EUPACHYCRINUS MAGISTER. n. sp.

Plate I., Fig. 1, basal view ; Fig. 2, azygous side view.

This species is very large; calyx low and broad, somewhat saucer-shaped, bulged a little upon the azygous side, height about half the width, sutures deep, excavation extending about half the thickness of the plates, plates very strongly tuberculated, tubercles conical, elongated, and irregular in form and distribution.

The five basal plates are sunk in a cavity on the under side, projecting only half their length beyond the column; even this projection is tubercular; they form in the interior of the calyx a pyramid, which is pierced at the summit by a five-rayed opening, connecting with the canal in the center of the column; the points of the rays are rounded. The basal plates are made pentagonal by the truncation made at the points of the rays for the central canal. The diagrammatic views which have been made of the basal plates in this genus are incorrect in so far as they indicate a pentagonal opening with the angles directed toward the sutures, instead of truncating the plates, with a concave depression, for the five-rayed opening to the columnar canal. The two basals on the azygous side of the species before us are larger than the others, being nearly as large as the other three.

The subradials are very large, extend into the basal cavity and curve very gently upward; three are hexagonal, the two longer sides unite with the subradials, the two upper sloping sides, uniting with the first radials, are a little shorter, and the two under sides, uniting with the basals, are very short; two are heptagonal, the one upon the right of the first azygous plate being much larger, and, except the two short sides uniting with the basals, the other sides are of subequal length; the one upon the left has, in addition to the two short sides uniting with the basals, a short side adjoining the second azygous plate. Four of the first radials are pentagonal, twice as wide as high; the upper face is the full width of the plates, and projects over the interior of the calyx, so as to give the appearance of having great thickness when viewed from above. The other first radial, upon the right of the azygous plates, is quadrilateral, except a very slight truncation by the second azygous plate below the depth of the suture. The first radial is separated from the second, or brachial piece, on the outer face, by a wide suture, but within a crenated ridge extends from one angle of the plates to another, forming a pentagon, except as separated

by the second azygous plate; the ridge has a furrow upon the outer side in the central part of each plate, and within this there is a wide expansion which supports the brachial and arm pieces. The first azygous plate has four sides, rests between the upper sloping sides of two subradials, and the long under side of the first radial on the right, with the shorter side abutting upon the second azygous plate. The second azygous plate is hexagonal, curves inward and supports upon its two short inner faces the third and fourth azygous plates side by side. The vault and other parts unknown.

This species would seem to have its nearest affinity with *E. tuberculatus*, which is described in the Geo. Sur. Ill., Vol. II., p. 319; in that species, however, the plates are covered with regularly disposed, narrow, prominent tubercles, the tubercles being arranged in rows, while in this species there is no such arrangement. *E. tuberculatus* is figured in Geo. Sur. Ill., Vol. V., Plate XXIV., Figs. 9a and 9b, and the basal plates are proportionally larger, and the under sides of the subradials longer, than they are in the species under consideration, beside all the plates have a different shape, and the sutures are not excavated so deep as in the species before us.

Found in the Upper Coal Measures of Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

EUPACHYCRINUS SPHERALIS. n. sp.

Plate I., Fig. 3, basal view; Fig. 4, azygous side view.

This species is large and constricted at the top of the first radials; calyx somewhat like a widened or inflated sphere, width two-thirds greater than height, sutures distinct but not so deeply excavated as in *E. magister*; plates irregularly tuberculated, but tubercles not half as large as in *E. magister*.

Basal plates are sunk in a cavity on the under side, and project less than half their width beyond the column; subradials large, extend into the basal cavity and curve upward half the height of the calyx; three are hexagonal and two heptagonal; first radials pentagonal, though the one on the right of the azygous plates has a very short truncated side abutting upon the azygous plate; second primary radial, or first brachial piece, smaller than the first and of similar form, except inverted, and bears upon its upper sloping

Prof. Rolfe

sides the free arms; the one opposite the azygous side bears two arms, each of which has a single plate followed by a double series of interlocking ones; the others support four arms each; the upper sloping sides bear pentagonal plates, similar in form to the second radials, which are followed with a single plate that, in its turn, bears a double series of interlocking ones.

There are fourteen large, long arms, composed of a double series of interlocking pieces, rounded externally, and flattened upon the sides so that, in an accumbent position, they close somewhat like the arms of an *Ichthyocrinus*; the arms in our specimens are spread out and the extremities are not preserved; pinnules numerous, but not very long; column round, and rather small for such a large *Crinoid*.

This species has its nearest affinity with *E. verrucosus*, described in the *Trans. Chi. Acad. Sci.*, Vol. I., p. 117, and redescribed and figured in the Report on the Palæontology of Eastern Nebraska, page 150.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

ULOCRINUS. n. gen.

(Ety., *oulos*, solid, substantial; *krinon*, lily.)

This genus has a more or less globular or pyramidal calyx, and is related to *Eupachyocrinus* and *Delocrinus*. There are five basals, forming a slightly convex pentagonal disc, or a low cup; they are of the same size and usually anchylosed; on the interior of the cup the columnar extension is round, depressed below the interior surface of the plates, and radiately furrowed like the articulating faces of the plates of many crinoid columns; on the exterior a star-like, columnar opening truncates the basal plates with the points of the five rays, between which there are radiating furrows for the attachment of the first columnar plate; by this arrangement the points of the basal plates are very thin, and disconnected only by the star-like perforation.

There are five subradials, each one of which may be as large or larger than the five united basals; all regularly alternate with the basals, and have the same form, except that one may be truncated by an azygous plate.

The first primary radials are pentagonal and regularly alternate with the subradials, except as interrupted by an azygous plate; they are much wider than high; the upper face is the full width of the plate, and projects over the interior of the calyx, so as to make a broad articulating face for the first brachial piece; the internal side of the first radial is concave; on the upper face of the plates a furrow extends from one angle of the plates to another, on the inner side of which there is a crenulated ridge, for the articulating brachial piece, and an interior central depression, and slight concavity at the central, internal margin.

There are no regular interradians. A single large quadrangular azygous interradian rests obliquely between two subradials and two primary radials, and forms part of the wall of the calyx; upon an angle of this, at the top of the calyx, a small plate intervenes and projects slightly above the first radials. The column is round. Other parts unknown, though very thick, heavy plates, bearing a spine like the first brachial plate of a *Delocrinus*, are found associated, and believed to belong to this genus.

The cup formed by the basal plates distinguishes this genus from *Eupachyrinus* and *Delocrinus*, both of which have a concave base and an interior pyramid formed by the basals; the second azygous plate does not truncate a subradial, and forms no part of the wall of the calyx in this genus, as it does in *Eupachyrinus*. It is probably as nearly related to *Delocrinus* as it is to *Eupachyrinus*, though at first view it would seem to be more nearly related to the latter. Type *U. buttsi*.

ULOCRINUS BUTTSI, n. sp.

Plate I., Fig. 5, azygous side view; Fig. 6, basal view.

The calyx of this species is pyramidal or has the form of half an ellipse, elongated; the plates are moderately thick, and convex externally so as to throw the sutures into wave like depressions; the sutures are distinct, but the plates are not deeply beveled as is common in many species of *Eupachyrinus*; the surface was, probably, strongly granulous, as the better preserved plates are rough, though evidently slightly worn.

The basal plates are large and form a cup about half as high as wide; the perforation for the columnar canal is pentagonal and

star-like; the subradials are very large and longer than wide, which produces the great length or pyramidal form of the calyx; four of the plates are hexagonal and one heptagonal; four of the first radials are pentagonal, wider than long and truncated above the full width of the plates; the one on the right of the azygous side is possibly hexagonal, as one side may be slightly truncated by the second azygous plate; the upper face of the first radials bears a furrow extending from one angle of the plates to another, behind which there is a narrow, crenulated ridge, on which the second radials or brachial pieces articulated. The first azygous plate is irregularly quadrangular and rests obliquely in a notch on the top of a subradial and below the under sloping side of the first radial on the right, but it does not reach the second subradial. The second azygous plate is injured in our specimen, but it appears to have slightly truncated one angle of the first azygous plate, and the two abutting first radials at the top of the calyx.

Found in the Upper Coal Measures, at Kansas City, Mo., and now in the collection of Wm. F. E. Gurley. The specific name is in honor of Mr. E. Butts, of Kansas City, who has done a great deal to make known the Natural History of that vicinity.

ULOCRINUS KANSASSENSIS, n. sp.

Plate I., Fig. 7, azygous side view; Fig. 8, outline view regular side;

Fig. 9, top view of calyx to show the prolongation of the first radials and contracted opening of the calyx; Fig. 10, basal view.

The calyx of this species is somewhat half-globular in form, though the height is more than two-thirds the width at the top; the plates are moderately thick and quite convex externally, so as to place the sutures in wave-like depressions quite as deep as they are in *U. buttsi*; sutures distinct, but the plates are not beveled; surface granulous.

The basals form an equal-sided convex pentagon, with a central depression for the star-shaped columnar canal; the subradials are each about the size of the united basals, a little wider than high, all pentagonal and nearly equal-sided except the hexagonal plate supporting the lower face of the azygous plate. The first radials are pentagonal, except the one on the left of the azygous plates, which becomes hexagonal by the very slight truncation made by

the second azygous plate; they are twice as wide as high; the upper face is the full width of the plate, and extends internally nearly one-third the diameter of the calyx; in the specimen described the width of the calyx is 1 3-10 inches, and the projection of these plates 4-10 inch, leaving the opening at the top of the calyx only 1-2 an inch, while the great concavity on the inner side of these plates will give an internal diameter of the calyx immediately below the top of the first radial of nearly an inch; the upper surface is broader than it is in *E. buttsi*, but the markings for the articulating brachials seem to be about the same.

The azygous plate forms part of the calyx, is quadrangular, nearly as large as a first radial, rests obliquely between two subradials and the under sloping side of the right first radial and a second under sloping side of the left first radial; the upper angle extends about as high as the upper face of the radials, and is very slightly if at all truncated by an angle of the small second azygous plate.

This species is remarkable for the great overlapping or interior projection of the first radials, and in this respect exceeds all known species of *Delocrinus* and *Eupachyrcrinus*. No part above the first radials is known, but some equally remarkably thick brachial plates, each bearing a very large spine, occurring at Rock Creek, in Jefferson County, Kansas, appear to belong to this species.

Found at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

DELOCRINUS, n. gen.

Ety.: *delos*, manifest, clear; *krinon*, lily.

The species belonging to this genus are usually robust, calyx basin-shaped, arms broad, composed of a double series of interlocking pieces joining neatly with each other, column round, plates thick, and surface smooth or finely granulous, not sculptured; basals five, occupying a concavity on the under side, and more or less hidden by the column, but forming a little cone in the interior of the calyx; subradials pentagonal and hexagonal, larger than the basals, the lower part inflexed by the depression of the base to meet the basal plates, the middle regularly arched, and the upper part forming a more or less acute angle between the under sloping sides of the first radials; first radials wider than high, pentagonal,

upper face truncated the entire width of the plate, and separated from the second radial or brachial plate on the outer face by a strong suture, but immediately within a straight crenated ridge extends from one outer angle of the plates to the other, on the upper face of the plates, which is furrowed upon each side so as to form a toothed hinge upon which the second radial or first brachial articulates; behind this hinge, in the middle part of each plate, there is a depression or socket for the reception of a tooth-like projection; on the under side of the second radial or brachial, a dart-shaped furrow also extends on the upper side along the line of union of the plates, commencing just within the angle arising from the union of the crenulated ridges and extending to the interior of the cup which receives a corresponding projection from the second radials; second radials or brachials pentagonal, produced externally in a more or less strongly developed spine, and bearing upon the upper or inner sloping sides the free arms, the first one or two plates of which are single, but above these composed of a double series of interlocking plates; when the arms are closed the pinules are within, and the body is compact something like an *Encrinurus*; there are no regular interradians; a single azygous interradian rests upon the truncated upper end of a subradial, between two first radials, and extends upward between the second radials or brachial plates; it is truncated at the upper end and followed by a single piece, beyond which the connection with the vault or proboscis is unknown. Type D. hemisphericus.

The species upon which this genus is founded was first defined by Shumard under the name of *Poteriocrinus hemisphericus*, in 1858, in the Transactions of the St. Louis Academy of Science, Vol. I, p. 221. Meek, in 1872, under the name of *Scaphiocrinus* (?) *hemisphericus*, Shumard, in the Report on the Palæontology of Eastern Nebraska, p. 147, Pl. V., Fig. 1a, 1b, and Pl. VII., Fig. 1a, b, c, redefined and illustrated *Cyathocrinus inflexus* of Geinitz, which is a distinct species as pointed out by Geinitz, though congeneric. In 1873, under the name of *Scaphiocrinus* (?) *hemisphericus*, Shumard, in Geo. Sur. Ill., Vol. 5, p. 561, Pl. XXIV., Fig. 5, Meek, probably, correctly identified and illustrated this species.

In 1880, in the Proceedings U. S. National Museum, Vol. 2, p. 257, White described a species under the name of *Erisocrinus planus*, which was redescribed and figured in Hayden's Twelfth

Ann. Rep. Geo. Sur. Terr., p. 127, Pl. XXXV., Figs. 5a and 5b under the name of *Erisocrinus* (*Ceriocrinus*) *planus*. *Ceriocrinus* being proposed and described as a subgenus of *Erisocrinus* and a comparison made with the *Poteriocrinus hemisphericus* of Shumard, and *Cyathocrinus inflexus* of Geinitz. *Ceriocrinus* was preoccupied, in the Echinodermata, by Koenig, and hence the use of the word by White is not allowable. The genus here under consideration and founded upon the *Poteriocrinus hemisphericus* of Shumard is not a subgenus of *Erisocrinus*, nor does it have any near affinity with it, probably not even family affinity, as will be apparent on the inspection of the species of *Erisocrinus* which have been illustrated. Its nearest generic relations are with *Eupachyrcinus* or *Ulocrinus*. The *Erisocrinus planus* of White may not be congeneric with this species, because the small azygous plate does not rest on a subradial but stands upon two radials and projects upward between two second radials. Only the calyx is known, and it may be that other parts when found will distinguish it from this genus, or possibly unite it with *Erisocrinus*. We are inclined to believe that Wachsmuth & Springer were not very careful in their examination of these forms, for when referring to the two species, *hemisphericus* and *planus*, near the top of page 254, pt. 3, *Palæocrinoidea*, they are made to say, "We, therefore, can not agree with White in considering the two forms generically identical, and much less specifically," and yet, near the bottom of the same page they refer both *hemisphericus* and *planus* to White's proposed genus *Ceriocrinus*, and under the name of *Ceriocrinus hemisphericus*, they refer with approval to Meek's identification in the Report on the Palæontology of Eastern Nebraska, p. 147, which is simply a reproduction of the *inflexus* of Geinitz, which is a distinct species that they recognize on the same page.

In the North American Geology and Palæontology, S. A. Miller condemned *Ceriocrinus* of White on the ground that the name was preoccupied, and referred the *hemisphericus* to *Eupachyrcinus*, the nearest allied genus then described.

This genus, so far as known, is confined to the Coal Measures of the Western States and Territories. We refer the following species to it:

Delocrinus craigi, (*Eupachyrcinus craigi*) Meek & Worthen, Geo. Sur. Ill., Vol. VI, p. 527, Pl. XXXII., Figs. 1 and 1a.

Delocrinus fayettensis, (*Eupachyrcinus fayettensis*) Worthen, Geo. Sur. Ill., Vol. V, p. 565, Pl. XXIV., Figs. 10, 10a.

Delocrinus hemisphericus, (*Poteriocrinus hemisphericus*) Shumard, Trans. St. Louis Acad. Sci., Vol. I, p. 221. Type of the genus.

Delocrinus inflexus, (*Cyathocrinus inflexus*) Geinitz, Carb. und Dyas in Nebraska, p. 62, Pl. IV., Figs. 20a, b, c, and doubtless the spines and some of the plates and fragments of columns figured on the same page under the name of *Actinocrinus* sp. The spines figured by Meek in the Report on the Palæontology of Eastern Nebraska, Pl. V., Figs. 2a, 2b and 2c, under the name of *Zeaocrinus mucrospinus* probably belong to this species, while the form Fig. 1 called *Scaphiocrinus* (?) *hemisphericus* may be distinct. *Delocrinus missouriensis* n. sp. And very doubtfully the *Eriocrinus planus* of White above referred to.

DELOCRINUS HEMISPHERICUS, SHUMARD.

Plate II., Fig. 8, side view showing azygous plate and first brachial, with spine; Fig. 9, basal view of same; Fig. 10, inner side of brachial spine magnified two diameters.

Shumard defined this species as follows:

"The *body* of this species is sub-hemispherical, concave below and the surface finely granulose.

"The *base* is very deeply concave, pentagonal and completely concealed from view when the column remains attached to the cup. The five pieces of which it is composed are of a rhombic shape, longer than wide, and the interior edges nearly double the length of the exterior ones.

"The *columnar facet* is circular, crenulated on the border; the central perforation rather large and pentalobate. In the interior of the calyx the base forms an elevated conical protuberance.

"The *sub-radial* pieces are thick and longitudinally recurved; four of them are pentagonal, a little longer than wide, their superior edges gently arched and slightly longer than the infero-lateral edges; the basal edges are very short. The fifth sub-radial is hexagonal, its superior angle being truncated to support an anal piece.

"The *first radial pieces* are pentagonal, very massive, and as wide again as long. The inferior edges are slightly concave and of equal length in three of the pieces, but on the anal side they are

unequal. The superior edge is nearly straight and rounded. The articular facet is very broad, nearly horizontal, and furnished with a prominent transverse ridge, which is situated nearest the external margin. Exterior to this is a small ridge which coalesces with the main one before reaching the extremity of the pieces. Both ridges are strongly crenulated.

"Anal pieces"—Of these pieces only one remains in the specimens before us. It is rather small, elongate hexagonal, and is wedged in between two of the first radials, above which it projects about half its length.

"The secondary radials, vault, arms and column are unknown.

"Dimensions."—Height of calyx, .30; width, .90; height of first radial pieces, .26; width of same, .42."

His specimens were from Hinkston Creek, Boone County, and on the Missouri River near Lexington, while our specimens are from Kansas City in the same vicinity. His definition is complete, as far as it goes, and we may add only that which our specimens disclose in addition.

The column is round and composed of alternately thicker and thinner plates radiately furrowed near the outer circumference of the articulating faces; the second radial or brachial articulates upon the crenated ridge on the top of the first radial, bears a tooth-like process that enters the socket in the middle of the posterior part of the first radial, and lateral processes that fill the furrows at the uniting joints of the first radials, and bears a strong spine, externally, that is directed upward at an angle of about forty-five degrees; the plates bear upon their upper inner sides the free arms; arms ten, the first plate articulates upon a serrated edge of the second radial, the next plate is wide and thin, and above this the arm consists of a double series of thick interlocking plates that make coarse wide arms, depressed convex externally, and flattened upon the sides almost as if cut by a knife so as to close up tight like an Encrinurus; the first azygous plate is truncated and subquadrate upon the upper face which is serrated near the outer margin for the articulation of the second plate; beyond this the vault is unknown.

DELOCRINUS MISSOURIENSIS, n. sp.

Plate II., Fig. 11, side view showing column; Fig. 12, basal view; Fig. 13, azygous side view.

This species may be distinguished at first view from *D. hemisphericus* by the lower calyx and more angular outline, and the top of the calyx when viewed from below presents a pentangular outline; the basals extend slightly beyond the column; the subradials in the median part are sharply convex as distinguished from the gently arching plates in *D. hemisphericus* and do not extend as high proportionally as they do in the latter species, which reduces the height of the calyx; first radials regularly convex in the middle part but depressed medially toward the upper face of the plates which produces the pentangular outline when viewed from below; the second radials or brachials while exposing a very wide suture are not quite as thick and do not stand as upright as they do in *D. hemisphericus*, and have a more slender spine; the azygous plate is the same as in *D. hemisphericus*; the column is not as regular in the alternate arrangement of the thicker and thinner plates as in *D. hemisphericus*, the larger plates project far beyond the thinner ones and sometimes there are two or more thinner plates between the thicker ones.

Found in the Upper Coal Measures, in Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

ÆSIOCRINUS, n. gen.

(Ety.: *aisios*, auspicious, coming at good time; *krinon*, lily.)

Column pentagonal; calyx bowl-shaped, plates smooth or finely granulous; basals five, forming a pentagonal flattened or slightly concave disc; subradials rather large, four hexagonal and one heptagonal, and curving upward so as to reach half the height of the calyx; first radials five, pentagonal, wider than high and truncated the entire width for the brachials; one or more brachials in each ray supporting strong arms composed of a single series of plates; arms ten bearing pinnules; no regular interradials; a single azygous interradial rests upon the truncated upper end of a subradial, between two first radials, and is followed by two plates that connect with the base of the proboscis; proboscis long, composed of four series of gradually tapering plates bearing numerous transverse respiratory fissures or slits on the sides of the plates.

The calyx of this genus bears some resemblance to that of an Erisocrinus, but the pentagonal column and azygous plate distinguish it. The azygous plate truncates a subradial as in Delocrinus, but otherwise there is no resemblance between the two genera. The long flowing arms composed of single plates and the remarkably large and peculiarly constructed proboscis characterize this genus and distinguish it from all others. Its family affinities would seem to be with the Poteriocrinidæ, but probably a new family should be defined for its reception.

ÆSIOCRINUS MAGNIFICUS, n. sp.

Plate II., Fig. 1, natural size of a specimen as it lies on a slab; Fig. 2, a free proboscis nearly entire and only slightly twisted; Fig. 3, portion of same magnified $2\frac{1}{2}$ diameters to show more distinctly the respiratory openings; Fig. 4, an abnormal branching proboscis; Fig. 5, sectional end view of proboscis.

Calyx deep, bowl-shaped, surface of plates finely granulous; sutures distinct but not beveled; basals forming a pentagonal flattened disc having an outline about twice the diameter of the column; subradials rather large, four hexagonal, one heptagonal, bending abruptly upward from the union with the basals, the upper angle extending high between the first radials so as to make the upper sloping sides of the hexagonal plates much the longer; first radials larger than the subradials, about one-half wider than high, all pentagonal with lateral and inferior sides of equal length and upper truncated sides extending to the fullest width of the plates; first brachial plates wide, short, rounded, separated exteriorly from the first radials by a beveled suture; second brachials wide, short, with long upper sloping sides for the articulation of the large arm plates; arms ten, long, round exteriorly and composed of short cuneiform plates; pinnules short and rather thick. Proboscis remarkably large, long and composed of four series of gradually tapering convex, tuberculated plates, somewhat similar in appearance to four round tapering columns placed together, giving transversely a subquadrate outline; there is no azygous or anal opening in the proboscis, but there are numerous transverse, respiratory fissures or slits in the longitudinal depressions; these slits exist on both

sides of every plate of the proboscis from the second brachials to the very top; some specimens of the proboscis have one or more intercalated plates near the lower end, and all are more or less twisted. There is a bifurcated proboscis in the collection which has five series of plates below the bifurcation, and three intercalated series at the bifurcation, so that each branch has four series, which we have illustrated. It is an abnormal specimen that may have resulted from an injury. The column is small, pentagonal, tuberculated and bore cirrhi to a greater or less extent.

This species was collected in the Upper Coal Measures, at Kansas City, and the specimens are in the collection of Wm. F. E. Gurley, of Danville, Illinois.

ÆSIOCRINUS HAREI, n. sp.

Plate III., Fig. 1, natural size as it lies upon a slab.

This species is distinguished from *A. magnificus*, by having proportionally a much smaller and a smooth proboscis. The calyx is bowl-shaped; column pentagonal; basals of moderate size; subradials convex and extending half the height of the calyx; first radials wider than high; first and second brachials and arms as in *A. magnificus* but proportionally smaller. The proboscis is much smaller in proportion to the size of the calyx than it is in *A. magnificus*, and the exterior of the plates is smooth, though the respiratory fissures in the two species are alike. This species is thus founded upon the surface character of the proboscis, and the proportionally larger calyx when compared with other parts of the body and arms.

These Kansas City fossils were collected in blue clay, where they were remarkably well preserved; but some specimens were injured by the collectors, who undertook to wash them when no water should have been applied. Many of the specimens were found with the heads downward and the arms spread out, leaving the base of the calyx upward, with the strong proboscis pressed to one side as shown in the illustration of this species.

From the Upper Coal Measures of Kansas City, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of Sidney J. Hare.

HYDREIONOCRINUS PENTAGONUS, n. sp.

Plate II., Fig. 6, view of azygous side showing height of calyx and upper truncated face for second radials; Fig. 7, basal view.

Calyx large, pentagonal and exceedingly depressed to the top of the first radials; plates very thick and sutures well defined; basals rather large and forming an octagonal ring around the end of the column, against the faces of which the subradials and three of the radials rest; subradials small, three triangular, one quadrangular, and the other pentagonal by reason of supporting the first azygous plate; they are slightly convex, and lie in furrows made by the angular convexity made by the first radials; first radials about twice as wide as high, the height not much exceeding the thickness of the plates; the plates are hexagonal, highly convex, depressed toward the sutures, and truncated upon the outer faces, so as to give the calyx a pentagonal outline; the depressions at the sutures appear as furrows in the pentagonal outline of the calyx; first azygous plate quadrangular, narrow, resting upon the upper sloping side of a subradial and forming the bottom of the furrow between two first radials; second azygous plate heptagonal, slightly truncating two first radials; column round.

Second radials and succeeding parts above unknown, and it is therefore possible that this species is a *Ceacrinus*, but from the characters given the inference is, it possessed the ventral sac of an *Hydreionocrinus*, beside the latter genus had, so far as known, its greater development in the Upper Coal Measures, while the former is more characteristic of the upper part of the Subcarboniferous or Kaskaskia Group. It is unnecessary to compare this with any species heretofore defined, because it is easily recognized by its strongly marked characters.

Collected in the Upper Coal Measures at Kansas City, and now in the cabinet of Wm. F. E. Gurley, of Danville, Illinois.

ONYCHOCRINUS ULRICHI, n. sp.

Plate III., Fig. 2, azygous side; Fig. 3, symmetrical side, natural size.

Calyx depressed, saucer-shaped; plates finely granulous, sutures distinct; basals three, extending slightly beyond the column; four of the subradials pentagonal, the one opposite the azygous side

being the larger one and all sharply pointed at the upper angle; the other one is hexagonal with an upper concave articulating facet for the first azygous plate; primary radials five in each ray, very gradually decreasing in size upward and becoming more and more sharply rounded; each one is wider than high and the sutures are transverse, with the exception of a slight concave central, exterior depression; the fifth plate is angular in the central part of the upper face and supports the two series of brachials; the brachials and arms are very short and thick, and the sutures between the plates become more and more sinuous toward the extremities; the first arm is given off at about the fourth brachial, and above this there are twelve or more short, branching, curving arms that form a cluster at the end of each ray.

The first regular interrarial is large and octagonal; it is followed by three plates and these by five, and above they are smaller and more numerous; four interbrachial pieces are visible in our specimen, and there are, probably, more; the azygous plates are small, short, and sutures sinuous.

Found in the Keokuk Group, at Crawfordsville, Ind., and now in the collection of Wm. F. E. Gurley. The specific name is in honor of Prof. E. O. Ulrich, of Newport, Ky.

AGARICOCRINUS SPLENDENS, n. sp.

Plate IV., Fig. 1, side view with arms; Fig. 2, basal view of same.

This species is of medium or rather under medium size; base concave; surface granulous; basals small; first radials small; second radials quadrangular, wider than long; third radials pentagonal, wider than high, and supporting upon each of the upper sloping sides a thin brachial plate, which is followed by another thin plate having two upper slightly sloping sides which support the regular interlocking series of the arm plates; arms, twelve, three in each ray adjoining the azygous side, and two in each of the other three rays; they are a little longer than the greatest diameter of the calyx, rather small and taper to a point; pinnules fine; regular interrarial areas narrow, the first plate resting between the second radials, which is followed by two smaller ones situate between the third radials and the first brachials; azygous area having one plate followed by three of nearly the same size,

which gives breadth to the area between the third radials and the brachial plates; the column is round and composed of alternately thicker and thinner plates. Our specimens do not show the vault.

This is a beautiful little species, quite different from any heretofore described, and occurs in the Keokuk Group, at Crawfordsville, Ind. It is in the collection of Wm. F. E. Gurley.

BATOCRINUS MARINUS, n. sp.

Plate IV., Fig. 3, side and basal view; Fig. 4, outline view of plates on azygous side.

Species of about the average size; calyx expanded at the arm bases so as to be wider than high and to make the openings through the vault from the arm furrows at right angles to the calyx; surface of the plates flattened and finely granulous; basals three, upright and forming a circle which appears as if it were the enlarged end of the column; first radials wider and larger than the second and third together, three heptagonal and two hexagonal; the upper face is truncated for the second radial, and the upper sloping sides support the first interradials; second radials quadrangular, a little wider than high; third radials wider than the second but not longer, pentagonal or hexagonal, the lower lateral sides spreading so as to give the greatest width at the angles made with the upper sloping sides; the upper sloping sides support the secondary radials; secondary radials two by ten, wider than long, somewhat variable in size and shape, the second one bearing upon its upper sloping sides a single tertiary radial; the tertiary radials are succeeded by a double series of interlocking arm plates; arms twenty, rather small, slender, gradually tapering and composed of a double series of plates, alternately interlocking; in our specimen they are coiled together on the vault around the base of the proboscis; pinules very numerous. Regular interradials five, the first one polygonal, about as large as a first radial and nearly as large as the other four; the first one is followed by two plates and these by two which are between the second secondary radials and the upper sloping sides of the tertiary radials; there is one intersecondary radial in each area; azygous interradials nine, the first one in line with the first radials and of the same size, this is followed by three smaller ones, and these again by three, and these by two which fit

between the under sloping sides of the tertiary radials; the proboscis is broken off in our specimen at the top of the folded arms.

Found in the Keokuk Group at Crawfordsville, Ind., and now in the collection of Wm. F. E. Gurley.

BATOCRINUS JUCUNDUS, n. sp.

Plate IV., Fig. 5, azygous side with arms; Fig. 6, symmetrical view with arms removed, showing proboscis.

Species rather small; calyx globose, nearly as wide as high, height of calyx a little more than height of dome to the base of the proboscis; arm bases very slightly projecting, and arm openings projected upward; surface of the plates smooth or finely granulous, more or less convex or tumid; basals three, short, upright, and forming a pentagonal ring around the column; first primary radials much wider and larger than the second and third together; on some specimens there is an elongated, transverse tubercle on each one, the upper face is broadly truncated for the inferior face of the succeeding radial, and the upper sloping sides support the first interradials; second primary radials quadrangular one-half wider than long; third primary radials wider and larger than the second, pentagonal or hexagonal, the lower lateral sides spreading so as to give the greatest width at the middle part of the plate or at the angles made with the upper sloping sides; the upper sloping sides support the secondary radials; secondary radials 2x10 wider than long, the upper the larger, but both of them variable in size and shape; six of them have upper sloping sides for tertiary radials, while four of them bear only a single tertiary radial; each second secondary radial in the ray opposite the azygous side bears a single arm and one of the lateral secondary radials on each side bears a single arm; there are, therefore, only sixteen arms; a single plate follows each tertiary radial, and above this the arm is constructed of two series of small plates alternately arranged; the arms are rounded on the outer side, gradually tapering and bear numerous long pinnules, composed of comparatively long pieces; regular interradials in some areas two and in others three, the first one polygonal and larger than any other plate above the first primary radials; when it is followed by two interradials they are together no larger than a single secondary interradial; azygous interradials

eight or nine, the first rests between the upper sloping sides of two basal plates and is in line with the first radials; it is followed by three plates in the second series, and in one specimen three plates in the third series and in another four; these are followed by a single plate projecting an angle up between the under sloping sides of tertiary radials; the vault and proboscis are constructed of highly tumid polygonal plates; the proboscis extends as far as or beyond the arms; column round.

This is a handsome little species, distinguished by its sixteen arms and the structure of the calyx from all others.

Found in the Keokuk Group at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

DICHOCRINUS CINCTUS, n. sp.

Plate IV., Fig. 10, symmetrical side view; Fig. 11, azygous side, showing vault and valvular opening; Fig. 12, summit view.

Calyx obconoidal, nearly twice as high as wide, somewhat truncated at the arm bases, except upon the azygous side, surface of the plates bearing a collection of fine longitudinal lines from the rim at the base, over the central part of the first radials, to the first rim plates, with fine transverse lines between, especially near the top of the calyx; sutures not impressed, and the transverse and longitudinal lines cross without interruption; the band or rim at the base suggests the specific name. The two basals form a little cup, the height of which is equal to the greatest diameter; they are contracted above the base so as to leave a small, smooth, half cylindrical rim or band at the bottom of the cup; the first radials are about twice as long as wide, very gradually increase in width to the upper truncated end, which bears a concave facet, a little more than one-third the width of the plate, for the attachment of the second radial or first brachial piece; second radial thin, rounded; the third radial a little thicker, rounded, and bearing upon its upper sloping sides the free arms; arms ten, long, rounded externally, composed of a single series of thin plates, bearing long, strong pinnules closely packed together.

Regular interradians forming part of the vault, and standing but very little above the upper truncated edge of the first radials; first azygous interradian as large as the first radials, inflected toward the

vault, and bearing fine longitudinal lines in the middle and lower central part, and transverse lines on each side of these on the upper part; the succeeding plates cover a moderately convex ridge, expanded a little above the other part of the vault which extends to the side of a central nipple occupying the summit of the vault, and at the junction there is a valvular opening, but it is not connected with the central elevation; this nipple-like elevation is covered with very small polygonal plates, and from the lower part of it five ambulacral ridges radiate to the second and third radials, which ridges are covered with minute polygonal plates. The column is round and composed of thin plates with sharp projecting edges.

Found in the Kinderhook or Waverly Group, at Le Grand, Iowa, and now in the collection of Wm. F. E. Gurley.

POTERIOCRINUS GRANILINEUS, n. sp.

Plate IV., Fig. 7, natural size.

Calyx low, basin-shaped; sutures well defined; basals small and hidden by the column; subradials small, hexagonal, except one on the azygous side, which is truncated at the top and heptagonal; first radials wide, short, pentagonal, and truncated on top, where they have their greatest width; second radials quadrangular, short, wider than the first, and having the greatest width at the upper truncated surface; third radials wider than the second, pentagonal, very short, with steep upper sloping sides, which are slightly curved to receive the free arms; arms short, composed of short cuneiform plates, so strongly arched in the middle as to form a subangular ridge down the back of all the rays, on which the granules are so united as to form a keel; all the arms preserved in our specimen (six in number) bifurcate on the sixth plate, and above this the bifurcations are irregular, one of them bifurcating on the fourth plate, and others do not seem to bifurcate at all; the arms are flattened so as to fit closely together as in *Zeacrinus*; pinnules not observed; the first azygous plate is inserted obliquely between a subradial and the under sloping side of a first radial, with the truncated lower end resting against another subradial; this plate is pentagonal; the second azygous plate rests upon the first above-mentioned subradial, and between the radials on the left and

the upper sloping side of the first azygous plate on the right; the higher azygous plates are not shown in our specimen; the column is rather small and obscurely pentagonal near the head.

The surface of the plates of body and arms is strongly granulated, and this, with the angularity of the arms and the union of the granules forming a sharp ridge or keel down all the rays, strongly characterize this species, and suggests the specific name. It probably belongs to that branch of the genus *Poteriocrinus* for which Wachsmuth suggested the name *Pachylocrinus*.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

POTERIOCRINUS CRAWFORDSVILLENSIS, n. sp.

Plate IV., Fig. 8, natural size.

Species large, robust; calyx obconoidal, expanding very gradually from the large column, longer than wide, and composed of smooth rounded plates with well defined sutures; basals large, widening but little upward, pentagonal, about as wide as high; sub-radials longer than wide, expanding but little upward, those shown in our specimen hexagonal, the two on the azygous side probably heptagonal; radials pentagonal, very little wider than high, the articulating surfaces occupying the entire width of the plates; the second radial or brachial plate in the ray opposite the azygous side is pentagonal, about as high as wide, rounded, and supports upon its two upper sloping sides free arms, one of which bifurcates on the third plate above, and the other does not divide; the arms are robust, long, very slowly tapering, rounded, and composed of thick cuneiform plates; column large, round, composed of thicker and thinner plates, the articulating faces of which are marked by radiating furrows, which show the serrated edges. Proboscis and other parts unknown.

This species belongs to that branch of *Poteriocrinus* for which Wachsmuth proposed the subgeneric name of *Scytalocrinus*. Its characters are very strongly marked, and it resembles *P. missouriensis*, from the St. Louis Group, about as much as it does any other species in the genus.

It was found in the Keokuk Group, at Crawfordsville, Indiana, and belongs to the collection of Wm. F. E. Gurley.

POTERIOCRINUS VERUS, n. sp.

Plate IV., Fig. 9, natural size.

Species medium size; calyx obconoidal, expanding very gradually, as long as wide, and composed of smooth rounded plates; sutures distinct; basals pentagonal, standing upright, nearly as high as wide; subradials hexagonal on the symmetrical side, about one-half larger than the basals and a little longer than wide; radials pentagonal, wider than high, a little smaller than the sub-radials, convex, truncated the entire width of the plates, with suture gaping; there are five brachials in two rays and seven in the other in our specimen before a bifurcation is reached; these plates are nearly as long as wide, round externally, and very slightly constricted, and the sutures are gaping; the last one has very steep upper sloping sides for the arms; arms ten, long, composed of very long constricted plates with slanting gaping sutures; proboscis long; our specimen shows five subquadrate plates where the arms are broken away, indicating that the proboscis extended nearly or quite to the ends of the arms. Column round, and articulating faces of the plates radiately furrowed.

Found at Le Grand, Iowa, in the Kinderhook or Waverly Group, and now in the collection of Wm. F. E. Gurley.

SCAPHIOCRINUS MANUS, n. sp.

Plate IV., Fig. 13, azygous side, natural size.

General form of calyx and arms having a fancied resemblance to a hand; calyx cup-shaped, height about half the diameter at the top, plates convex and sunken at the angles of the sutures; basals hidden within a shallow depression surrounding the end of the column; subradials hexagonal, except one on the azygous side which is truncated at the top and heptagonal; they are larger than the basals, and about half as large as the first radials; first radials pentagonal, one-half wider than high, convex at the upper part, truncated the entire width, and separated from the brachials externally by a wider suture. There is only a single brachial in each ray, and it is rather larger than a first radial, pentagonal, constricted, angular, and supports on its upper sloping sides the free arms; the two arms on the left of the azygous plate and the one

on the right bifurcate on the eighth plate, and the second arm to the right of the azygous plates bifurcates on the tenth plate; the plates are very slightly wedge-shaped, and have their thickest margins produced into nodes, the alternate arrangement of which gives the arms a rough aspect; pinnules coarse, making the head appear full and dense. The first azygous plate rests between the first two radials, the under side of the first radial on the right, and the second and third azygous plates; the second azygous plate is of the same size as the first, rests on the truncated end of a sub-radial, and abuts upon a first radial and brachial on the left, the first and third azygous plates on the right and another azygous plate at the top; the third azygous plate is a little smaller, and abuts a brachial on the right. Column and vault unknown.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

Plate I.

	Page.
Eupachyrcinus magister, n. sp	4
Fig. 1, basal view; Fig. 2, azygous side view.	
Eupachyrcinus sphæralis, n. sp	5
Fig. 3, basal view; Fig. 4, azygous side view.	
Ulocrinus buttsi, n. sp	7
Fig. 5, azygous side view; Fig. 6, basal view.	
Ulocrinus kansasensis, n. sp	8
Fig. 7, azygous side view; Fig. 8, outline view regular side; Fig. 9, top view of calyx to show the prolongation of the first radials and contracted opening of the calyx; Fig. 10, basal view.	

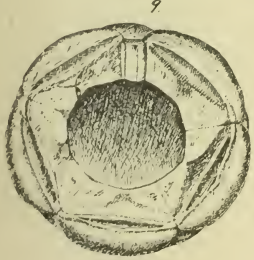
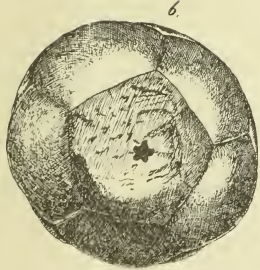
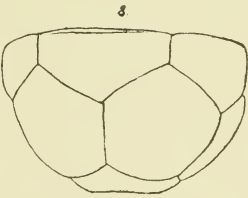
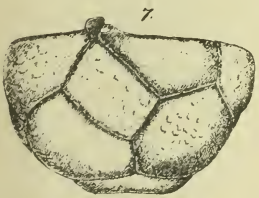
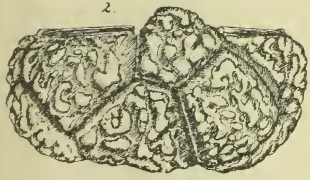
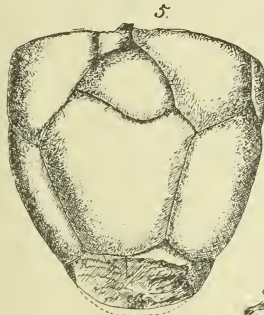
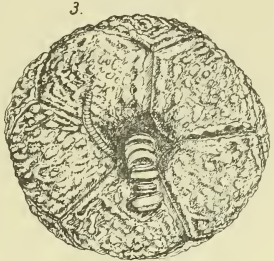
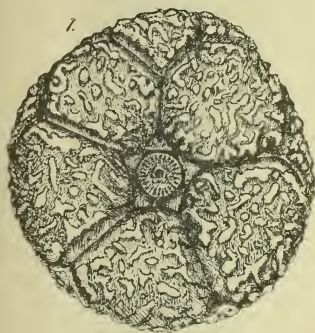




Plate II.

	Page.
<i>Esiocrinus magnificus</i> , n. sp	15
Fig. 1, natural size of a specimen as it lies on a slab; Fig. 2, a free proboscis nearly entire and only slightly twisted; Fig. 3, portion of same magnified $2\frac{1}{2}$ diameters to show more distinctly the respiratory openings; Fig. 4, an abnormal branching proboscis; Fig. 5, sectional end view of proboscis.	
<i>Hydreionocrinus pentagonus</i> , n. sp	17
Fig. 6, view of azygous side showing height of calyx and upper truncated face for second radials; Fig. 7, basal view.	
<i>Delocrinus hemisphericus</i> , Shumard	12
Fig. 8, side view showing azygous plate and first brachial, with spine; Fig. 9, basal view of same; Fig. 10, inner side of brachial spine magnified two diameters.	
<i>Delocrinus missouriensis</i> , n. sp	14
Fig. 11, side view showing column; Fig. 12, basal view; Fig. 13, azygous side view.	

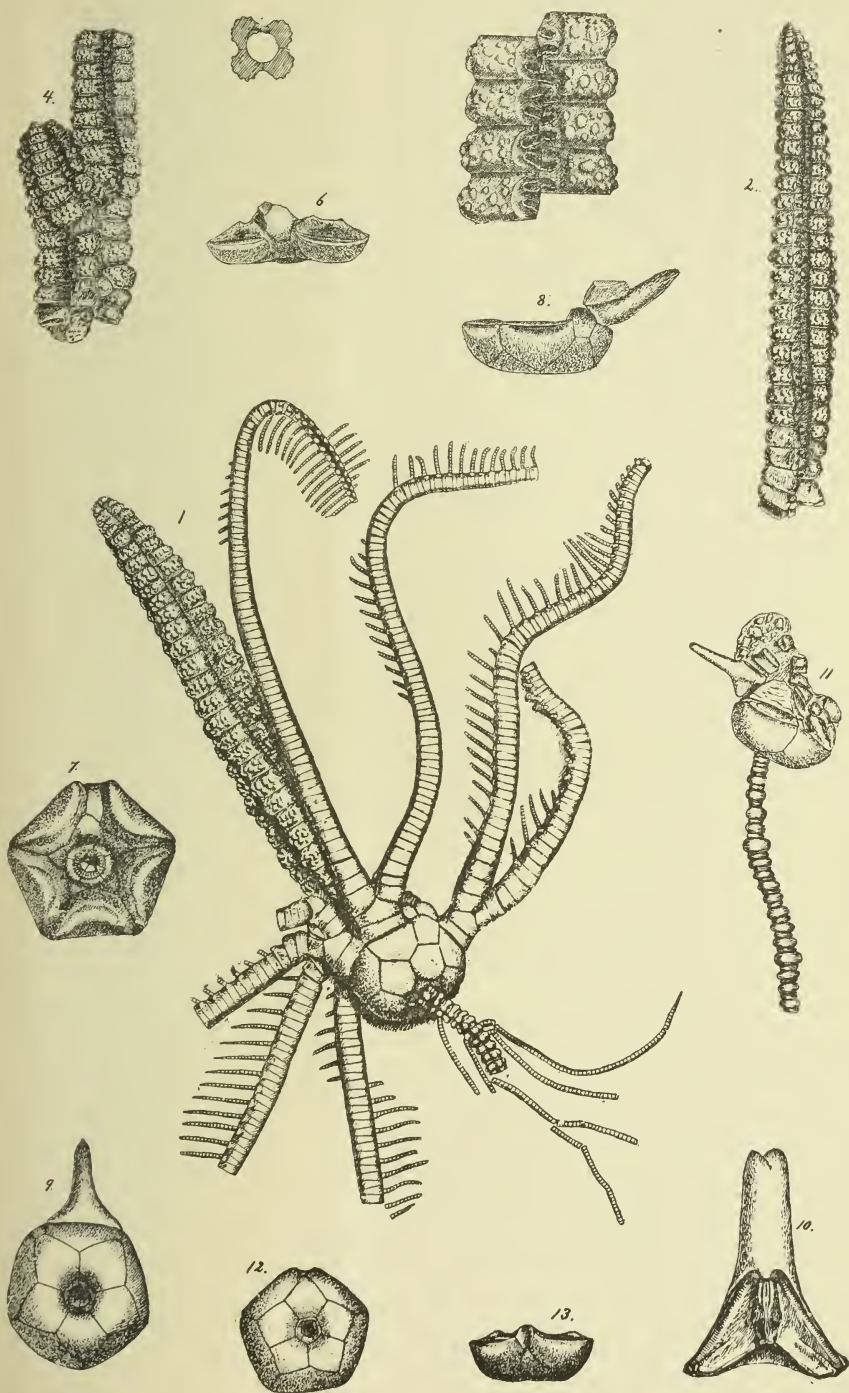




Fig. 1. *Alnus*

Alnus, *Alnus* (Fernald)

Alnus, *Alnus* (Fernald)

Alnus, *Alnus* (Fernald)

Alnus, *Alnus* (Fernald)



Fig. 2. *Alnus*

Plate III.

	Page.
<i>Æsiocrinus harii</i> , n. sp	16
Fig. 1, natural size as it lies upon a slab.	
<i>Onychocrinus ulrichi</i> , n. sp	17
Fig. 2, azygous side; Fig. 3, symmetrical side, natural size.	

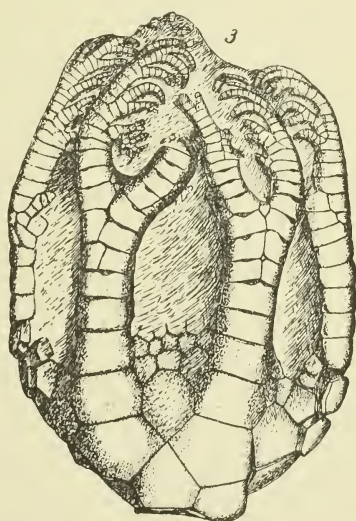
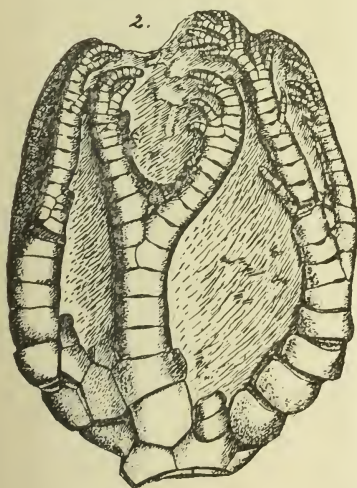
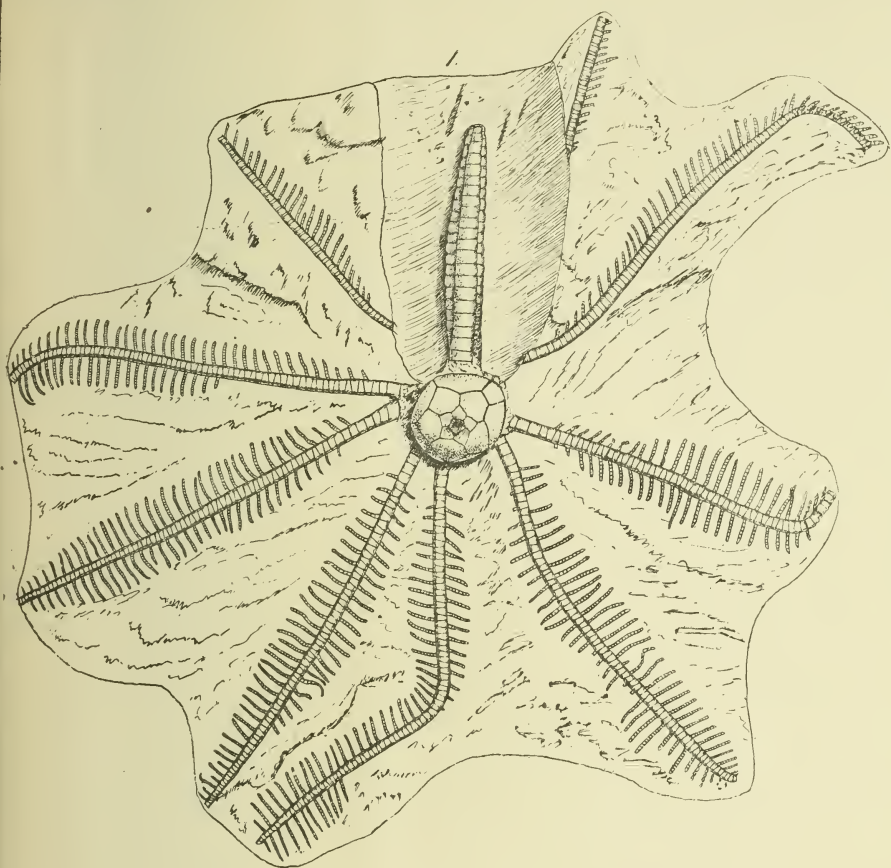




PLATE I

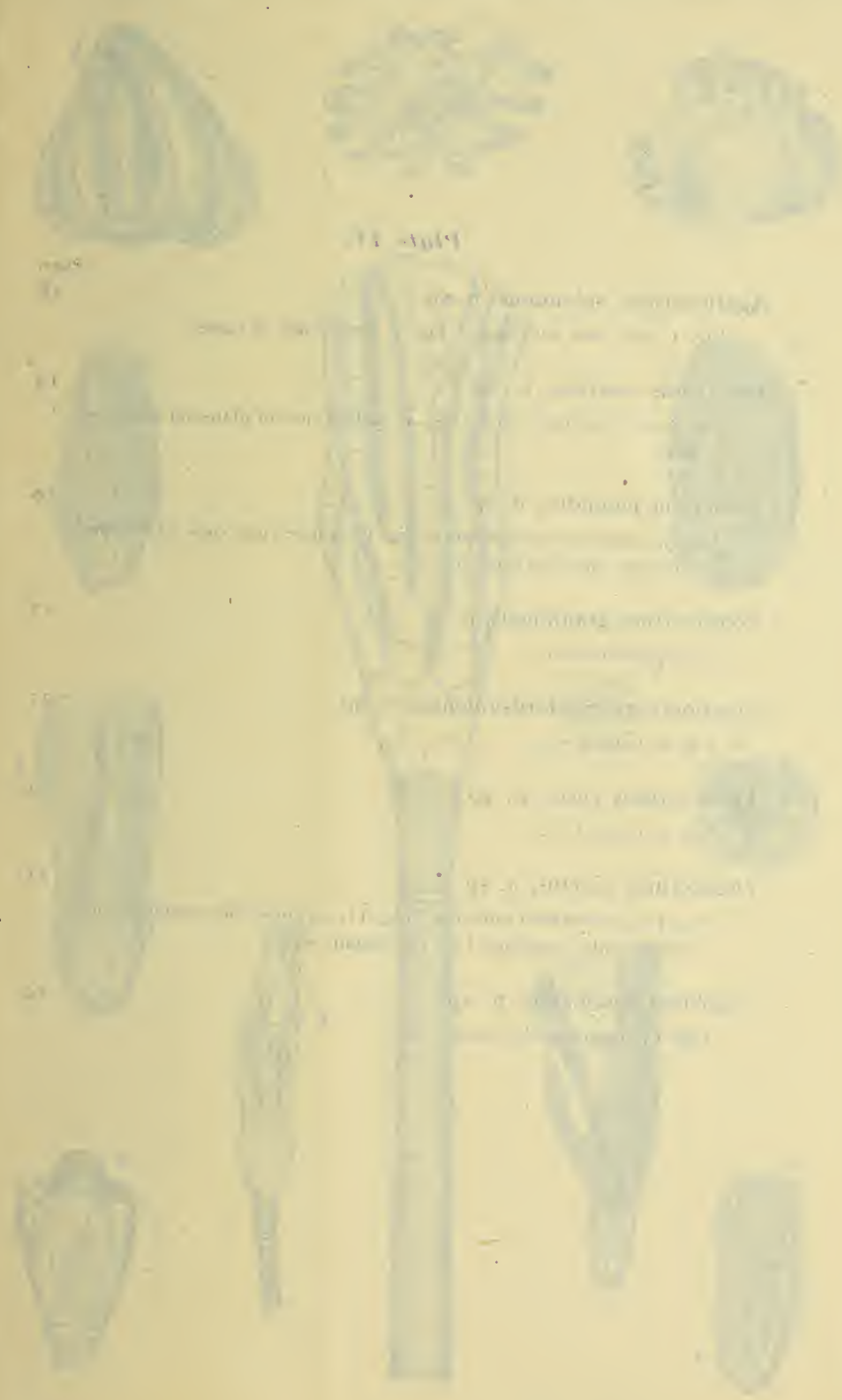
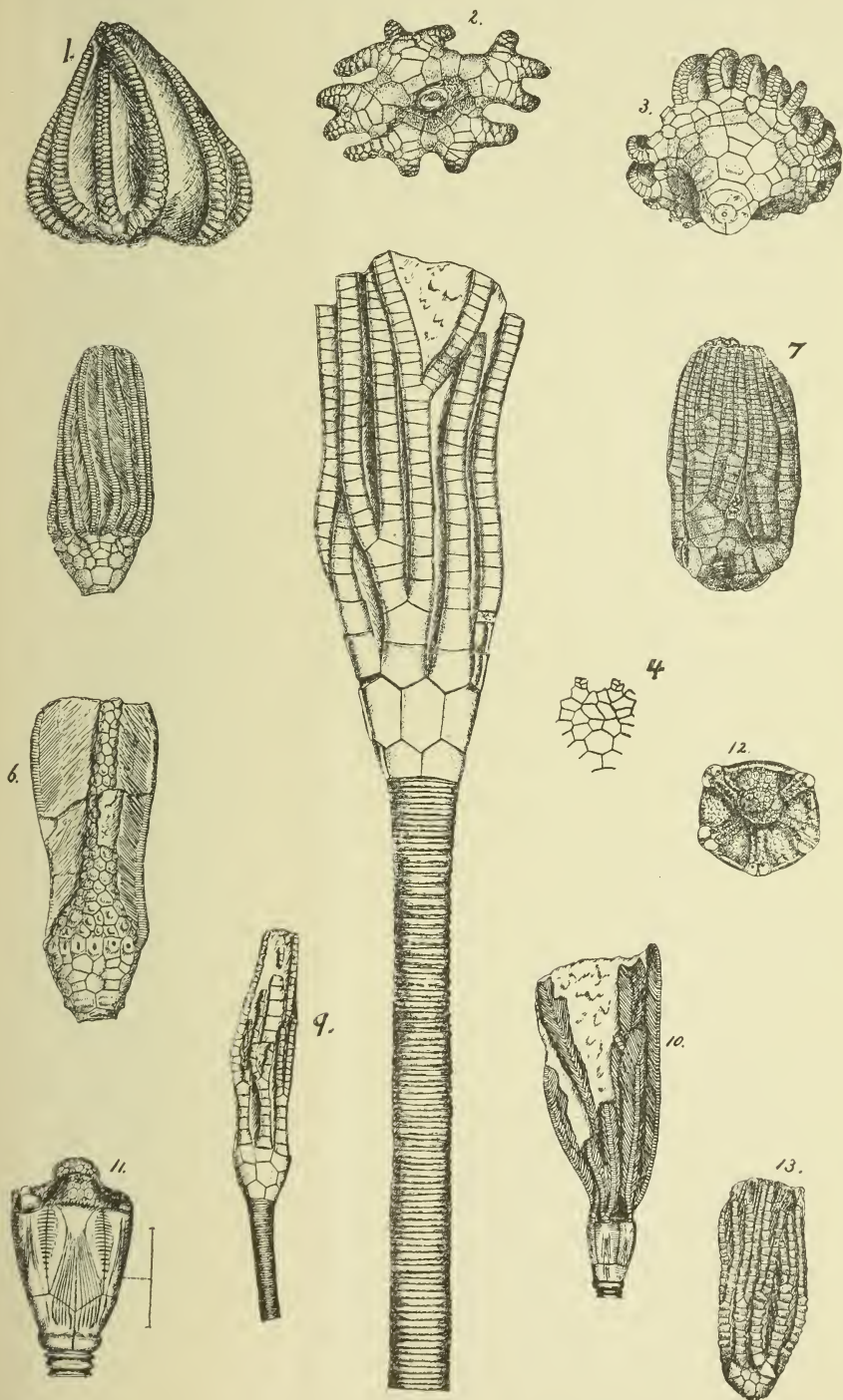


Plate IV.

	Page.
<i>Agaricocrinus splendens</i> , n. sp	18
Fig. 1, side view with arms; Fig. 2, basal view of same.	
<i>Batocrinus marinus</i> , n. sp	19
Fig. 3, side and basal view; Fig. 4, outline view of plates on azygous side.	
<i>Batocrinus jucundus</i> , n. sp	20
Fig. 5, azygous side with arms; Fig. 6, symmetrical view with arms removed, showing proboscis.	
<i>Poteriocrinus granilineus</i> , n. sp	22
Fig. 7, natural size.	
<i>Poteriocrinus crawfordsvillensis</i> , n. sp	23
Fig. 8, natural size.	
<i>Poteriocrinus verus</i> , n. sp	24
Fig. 9, natural size.	
<i>Dichocrinus cinctus</i> , n. sp	21
Fig. 10, symmetrical side view; Fig. 11, azygous side, showing vault and valvular opening; Fig. 12, summit view.	
<i>Scaphiocrinus manus</i> , n. sp	24
Fig. 13, azygous side, natural size.	











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